Numerical Simulation of Laser Driven Rayleigh-Taylor Instability by ILESTA-2D

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Abstract

One of the most important issues studying the Inertial Confinement Fusion (ICF) is hydrodynamic instability such as Rayleigh-Taylor instability and Richtmyer-Meshkov instability. Many works have been done to estimate the growth rate of the Rayleigh-Taylor instability in laser-accelerated targets. But there are still uncertain parameters to make quantitative prediction of the instability. Especially, a spike and bubble saturation, Kelvin-Helmholtz instability, ablation, thermal conduction and so on complicate the matter in non-linear phase. In such a case, computational simulations play an important role as well as the experiments. For these simulations, the computational code must be stable in numerically, robust without distorted meshes and less dissipative. Also, sophisticated physical models should be considered.

In the Institute of Laser Engineering, Osaka University, sophisticated 2-D Arbitrary Lagrangian-Eulerian hydrodynamics code, ILESTA-2D[1] have been developed for the study of hydrodynamic instability in targets accelerated by laser ablation and in ICF targets. This code consists of several parts, equations of fluid motion in two dimension Lagrangian coordinate, radiation transport, opacity, emissivity, equation of state, laser absorption. Recently, two major modifications have been done One was a development of rezoning/remapping algorithm based on Arbitrary Lagrangian Eulerian (ALE) method[2][3]. And a numerical algorithm in solving diffusion-type equations calculation was improved using ILUBCG method. These works enable to simulate strongly non-linear hydrodynamic instabilities without distorted meshes.

Using this code, various perturbations of the target surface and laser irradiations are simulated. Fig.1 and Fig.2 show one of the numerical results, the mass density contours and computational mesh respctively. These numerical results are compared with the experimental results by GXII in ILE and other facilities. The detail of the code and the feature of the nonlinear development will be discussed in this presentation.

Fig.1 Mass density contour

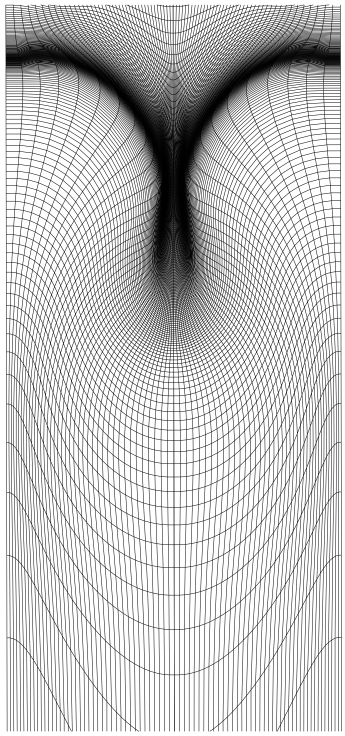

Fig.2 Computational mesh

References

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